CERTIFICATE OF VERIFICATION

I, Su Hyun LEE of 648-23 Yeoksam-dong, Kangnam-ku, Seoul, Korea state that the attached document is a true and complete translation to the best of my knowledge of the Korean-English language and that the writings contained in the following pages are correct English translations of the specifications and claims of the Korean Patent Application No. P2001-0083218.

Dated this 21st day of October 2005

Signature of translator: ____________________

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[ABSTRACT OF THE DISCLOSURE] **01-83218**

[ABSTRACT]

An LCD device and a method for fabricating the same is disclosed, in which column spacers are formed in the inside and the peripheral region of a sealant, to stabilize a sealant peripheral gap and to prevent a stress caused by the sealant, the LCD device including first and second substrates; gate and data lines, formed on the first substrate, for defining a unit pixel region; column spacers formed on the second substrate corresponding to the inside of the pixel region and an peripheral region of an array; a sealant formed on the second substrate; and a liquid crystal layer between the first and second substrates, the method for fabricating the LCD device including defining a unit pixel region by forming gate and data lines on a first substrate; forming column spacers on the second substrate corresponding to the inside of the pixel region and a peripheral region of an array; forming a sealant on the second substrate; and forming a liquid crystal layer between the first and second substrates.

[TYPICAL DRAWING]

FIG. 4C

[INDEX]

liquid crystal dropping, column spacer, sealant

[SPECIFICATION]

[TITLE OF THE INVENTION]

LIQUID CRYSTAL DISPLAY DEVICE AND METHOD FOR MANUFACTURING THE SAME

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a plane view of an LCD device using a liquid crystal dropping method according to a related art.

FIGs. 2A to 2G are cross-sectional views of a process of manufacturing an LCD device using a liquid crystal dropping method according to a related art.

FIG. 3A, FIG. 3C and FIG. 3D are cross-sectional views of IPS mode LCD devices according to the present invention.

FIG. 3B is a cross-sectional view of showing A of FIG. 3A.

FIG. 3E is a cross-sectional view of a TN mode LCD device according to the present invention.

FIG. 3F is a cross-sectional view of showing A' of FIG. 3E.

FIG. 4A is a plane view of an LCD device using a liquid crystal dropping method according to the present invention.

FIG. 4B is an expanded view of showing B of FIG. 4A, according to the first embodiment of the present invention.

FIG. 4C is an expanded view of showing B of FIG. 4A, according to the second embodiment of the present invention.

FIGs. 5A to 5G are cross-sectional views of a process of manufacturing an LCD device using a liquid crystal dropping method according to the present invention.

Description of reference numerals for main parts in the drawings

300, 400: first substrate
305, 405: column spacer
309: gate electrode
313, 326: common electrode
314: pixel electrode
315: semiconductor layer
316: source electrode
317: drain electrode
319: data line
320: gate insulating layer
321, 430: black matrix
322: color filter layer
322a: dummy color filter layer
323, 418: overcoat layer
325: passivation layer
330: liquid crystal layer
331: first alignment layer
335: second alignment layer
349: gate line
350, 450: second substrate
401: Ag
403: liquid crystal
403a: liquid crystal layer
410: UV-ray hardening sealant
412: unit pixel region
416: dummy column spacer
417: opening
420: active area
460: lower stage
470: upper stage
480: quartz stage

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND DISCUSSION OF THE RELATED ART]

The present invention relates to a liquid crystal display (LCD) device and a method for manufacturing the same, and more particularly, to an LCD device and a

method for manufacturing the same, in which column spacers are formed in the inside and the peripheral region of a sealant, thereby stabilizing a sealant peripheral gap and preventing a stress caused by the sealant.

Generally, an LCD device has such characteristics as low-voltage driving, low power consumption, full-color implementation, thin & compact size, and the like and is widely used for calculator, notebook PC, watch, PC monitor, aircraft monitor, personal mobile terminal, mobile phone, etc..

A size of the LCD device has a tendency toward a wide screen.. In fabricating the wide-screen LCD device, vacuum injection for forming a liquid crystal layer according to a related art takes too much time. Hence, a new liquid crystal dropping method of dropping liquid crystals on a substrate at vacuum ambience is used lately.

If the liquid crystal layer is formed by the liquid crystal dropping method, a fabricating time is reduced. The liquid crystal dropping method uses a UV-ray hardening sealant for bonding upper and lower substrates to each other.

The UV-ray hardening sealant is provided by mixing acrylate resin with photo-hardener, which becomes radical when a UV-ray is applied thereto, at a predetermined ratio. The photo-hardener reacts to acrylate to form polymer having strong adhesion to a glass substrate.

A spacer is used to equalize a cell gap when both of the substrates are bonded to each other. The spacer species include a ball spacer scattered on a substrate and a column spacer formed on a substrate. The ball spacer may vary the cell gap occasionally when being applied to a wide area.. Hence, the column spacer is mainly used.

If both of the substrates are bonded to each other by the UV-ray hardening sealant, portions of the substrates having the sealant formed thereon are strongly bonded

to each other by the adhesion of the sealant but array portions of the substrates are bonded weaker than the portions having the sealant. Hence, a stress is generated between the substrates.

An LCD device and a fabricating method thereof are explained by referring to the attached drawings as follows.

FIG. 1 is a plane view of an LCD device using a liquid crystal dropping method according to the related art. Referring to FIG. 1, a thin film transistor (TFT) array is formed in an LCD panel region on a first substrate 100 and an Ag pattern is formed in a peripheral region of the LCD panel region to apply a voltage to a terminal Vcom. Liquid crystals are then dropped in the LCD panel region. The liquid crystal display panel region has an active area 120 and a dummy area 130.

Meanwhile, a color filter pattern is formed in the LCD panel region on a second substrate 150, and column spacers 105 are formed in the portion to correspond to a line part excluding a pixel region 112 of the first substrate 100. The column spacers 105 having been formed on the second substrate 150 are attached to the second substrate 150. After the column spacers 105 have been formed, a UV-ray hardening sealant pattern 110 is formed on the second substrate 150.

Subsequently, an LCD panel is prepared by bonding the first and second substrates 100 and 150 to each other. A UV-ray is then applied to the UV-ray hardening sealant 110 to harden the UV-ray hardening sealant 110.

A cell gap in the active area 120 is maintained uniformly on the entire surface of the LCD device due to the column spacers 105 formed thereon.

Meanwhile, the UV-ray hardening sealant pattern 110 has a strong adhesion to pull the first and second substrates 100 and 150 toward each other. Hence, a portion

where the sealant pattern 110 is located receives a stress greater than the active area 120. Moreover, since the UV-ray hardening sealant pattern 110 pulls the first and second substrates 100 and 150 toward each other, the cell gap around the sealant pattern 110 may vary in accordance with a quantity of the sealant pattern 110.

FIGs. 2A to 2G are cross-sectional views of a process of manufacturing an LCD device using a liquid crystal dropping method according to a related art.

As shown in FIG. 2A, Ag pattern 101 is formed on a first substrate 100.

As shown in FIG. 2B, column spacers 105 are formed on a second substrate 150. The column spacers 105 are formed in correspondence with a line part of the first substrate 100.

As shown in FIG. 2C, a UV-ray hardening sealant 110 is coated on the second substrate.

Referring to FIG. 2D, a predetermined quantity of liquid crystal 103 is dropped on the first substrate. The second substrate 150 is disposed over the first substrate 100 to confront in a bonding machine, and the first and second substrates 100 and 150 are then bonded to each other. In other words, the second substrate 150 is fixed to an upper stage 170, which enables to move in a Z-axis direction (upper/lower directions), of the bonding machine. Meanwhile, the Ag pattern 101 is disposed on a periphery of the UV-ray hardening sealant 110 on the second substrate 150. And, the first substrate 100 is fixed to a lower stage 160, which enables to move in XY-axes directions, of the bonding machine.

Referring to FIG. 2E, the upper and lower stages 170 and 160 are aligned to each other and then a predetermined degree of vacuum of the bonding machine is achieved. Hence, the first and second substrates 100 and 150 are bonded to each other. Once both

of the substrates 100 and 150 are bonded to each other as the degree of vacuum of the bonding machine is achieved, a first cell gap is formed and then the bonded substrates 100 and 150 are discharged to the atmospheric environments.

Referring to FIG. 2F, once the bonded substrates 100 and 150 having the first gap are discharged to the atmospheric environments, a difference between an inner pressure of the LCD panel and the atmospheric pressure generates a second cell gap between the bonded substrates 100 and 150. In this case, the dropped liquid crystal becomes a liquid crystal layer 103a having a uniform thickness.

Referring to FIG. 2G, the bonded substrates 100 and 150 are placed on a quartz stage 180. A UV-ray is then applied to the bonded substrates from a lower side of the first substrate 100 to photo-harden the UV-ray hardening sealant pattern 110.

However, the LCD device and the method for fabricating the same according to the related art have the following problems or disadvantages.

First of all, the UV-ray hardening sealant pulls the bonded substrates while being hardened, thereby generating a stress between the active area part and the sealant pattern part.

Secondly, the UV-ray hardening sealant pulls the bonded substrates while being hardened, thereby varying the cell gap around the sealant pattern in accordance with the quantity of the sealant pattern.

[TECHNICAL TASKS TO BE ACHIEVED BY THE INVENTION]

An object of the present invention is to provide an LCD device and a method for fabricating the same, enabling to maintain a uniform cell gap in a portion having a sealant formed thereon.

Another object of the present invention is to provide an LCD device and a method for fabricating the same, enabling to lessen a stress caused by a sealant.

[PREFERRED EMBODIMENTS OF THE INVENTION]

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, an LCD device includes first and second substrates; gate and data lines, formed on the first substrate, for defining a unit pixel region; column spacers formed on the second substrate corresponding to the inside of the pixel region and an peripheral region of an array; a sealant formed on the second substrate; and a liquid crystal layer between the first and second substrates.

In another aspect of the present invention, a method for fabricating an LCD device includes defining a unit pixel region by forming gate and data lines on a first substrate; forming column spacers on the second substrate corresponding to the inside of the pixel region and a peripheral region of an array; forming a sealant on the second substrate; and forming a liquid crystal layer between the first and second substrates.

Hereinafter, an LCD device and a method for fabricating the same according to the present invention will be described with reference to the accompanying drawings.

FIG. 3A, FIG. 3C and FIG. 3D are cross-sectional views of IPS mode LCD devices according to the present invention. FIG. 3B is a cross-sectional view of showing A of FIG. 3A. FIG. 3E is a cross-sectional view of a TN mode LCD device according to the present invention. FIG. 3F is a cross-sectional view of showing A' of FIG. 3E.

As shown in FIG. 3A, a metal layer is deposited on a first substrate 300, and is the performed with photolithography, thereby forming a gate line (not shown), a

common electrode 313, and a gate electrode 309 at a position corresponding to a thin film transistor.

Then, a gate insulating layer 320 is formed on an entire surface of the first substrate 300 including the gate electrode 309, and a semiconductor layer 315 is formed on the gate insulating layer 320. In this case, the semiconductor layer 315 functions as an active layer.

Also, when forming a data line 319, source and drain electrodes 316 and 317 and a pixel electrode 314 are formed at the same time. The source and drain electrodes 316 and 317 are positioned in correspondence with the thin film transistor.

Then, a passivation layer 325 is formed on the entire surface of the first substrate 300 including the pixel electrode 314, and a first alignment layer 331 is formed on the passivation layer 325.

Next, a second substrate 350 is formed of a black matrix 321 and a color filter layer 322. Also, an overcoat layer 323 is formed so as to decrease a difference between the black matrix 321 and the color filter layer 322, and then is patterned. At this time, the overcoat layer 323 is formed of Cr, CrO_x or black resin.

Then, a column spacer 305 is formed in the inside of the array of the second substrate 350, and another column spacer 305 is formed in a peripheral region of the array, at the same time. After that, a second alignment layer 335 is formed on the column spacer 305 formed in the inside of the array and the column spacer 305 formed in the inside of a UV-ray hardening sealant. After coating the UV-ray hardening sealant 410, liquid crystal is dropped on the aligned first substrate 300. Then, the second substrate 350 is positioned over the first substrate 300, and then the first and second substrates are bonded to each other.

FIG. 3B is a cross-sectional view of showing A of FIG. 3A. As shown in FIG. 3B, the column spacer 305 maintains the predetermined gap between the first and second substrates 300 and 305 bonded to each other by the UV-ray hardening sealant 410.

Like FIG. 3A, FIG. 3C is a cross sectional view of an IPS mode LCD device according to the present invention. In case of the IPS mode LCD device shown in FIG. 3C, it doesn't pattern an overcoat layer 323. In this case, a column spacer 305 is formed in the inside of an array of a second substrate 350. At the same time, column spacers 305 are formed in the overcoat layer 323 corresponding to a peripheral region of the array and in a peripheral region of a UV-ray hardening sealant 410.

Then, a second alignment layer 335 is formed on the column spacer 305 positioned in the inside of the array, and on the column spacer 305 positioned in the overcoat layer 323 inside the UV-ray hardening sealant 410. After coating the UV-ray hardening sealant 410, liquid crystal is dropped on the aligned first substrate 300. The second substrate 350 is positioned over the first substrate, and then the first and second substrates 300 and 350 are bonded to each other.

At least two column spacers 305 are positioned at both sides of the UV-ray hardening sealant 410.

Like FIG. 3A and FIG. 3C, FIG. 3D is a cross sectional view of an IPS mode LCD device according to the present invention. In FIG. 3D, an overcoat layer 323 is patterned, and a dummy color filter layer 322a is formed on the overcoat layer 323. Also, a column spacer 305 is formed in the inside of an array of a second substrate 350. At the same time, a column spacer 305 is formed in the portion of the dummy color filter 322a corresponding to a peripheral region of the array, and another column spacer 305 is

formed in a peripheral region of a UV-ray hardening sealant 410. Then, a second alignment layer 335 is formed on the column spacer 305 positioned in the inside of the array, and on the column spacer 305 positioned in the inside of the UV-ray hardening sealant 410.

After coating the UV-ray hardening sealant 410, liquid crystal is dropped on the aligned first substrate 300. The second substrate 350 is positioned over the first substrate 300, and then the first and second substrates 300 and 350 are bonded to each other.

In the IPS mode LCD device, a common electrode 313 and a pixel electrode 314 may be formed at the different layers. The common and pixel electrodes 313 and 314 may be formed on a gate insulating layer, or the common and pixel electrodes 313 and 314 may be formed at the same layer as source and drain electrodes 316 and 317. The common electrode 313 may be formed at the same layer as a gate electrode 309, and the pixel electrode 314 may be formed on a passivation layer 325. The common and pixel electrodes 313 and 314 may be formed at the same layer on the passivation layer 325. Accordingly, the common and pixel electrodes 313 and 314 may be variable in position without regard to the structure of IPS mode LCD device.

As shown in FIG. 3E, a metal layer is deposited on a first substrate 300, and is performed with photolithography, thereby forming a gate line 349 and a gate electrode 309 corresponding to a position of a thin film transistor. Also, a gate insulating layer 320 is formed on an entire surface of the first substrate 300 including the gate electrode 309.

After that, a semiconductor layer 315 is formed on the gate insulating layer 320, wherein the semiconductor layer 315 functions as an active layer. Then, source and drain electrodes 316 and 317 are formed at both sides of the semiconductor layer 315.

Also, a passivation layer 325 is formed on the entire surface of the first substrate 300 including the source and drain electrodes 316 and 317, and a pixel electrode 314 is formed thereon. Then, a first alignment layer 331 is formed on the entire surface of the first substrate 300 including the pixel electrode 314.

Next, column spacers 305 are formed in the inside of an array of a second substrate 350, in a portion of a common electrode 326 on a peripheral region of the array, and in a peripheral region of a UV-ray hardening sealant 410.

Then, a second alignment layer 335 is formed on the column spacer 305 positioned in the inside of the array and on the column spacer 305 positioned in the common electrode 326 of the peripheral region of the array. The column spacer 305 positioned in the peripheral region of the UV-ray hardening sealant 410 is formed in the portion of the common electrodes 326. In this case, the second alignment layer 335 is not formed on the column spacer 305 positioned in the peripheral region of the UV-ray hardening sealant 410.

After coating the UV-ray hardening sealant 410, liquid crystal is dropped on the aligned first substrate 300. The second substrate 350 is positioned over the first substrate 300, and then the first and second substrates 300 and 350 are bonded to each other.

In addition to the TN mode, various modes of VA (Vertical Alignment), OCB (Optically Compensated Birefringence), FLC (Ferroelectric Liquid Crystal) and

reflective type can be applied. As shown in FIG. 3A, 3C and 3D, an overcoat layer may be formed on the color filter layer 322.

FIG. 3F is a cross-sectional view of showing A' of FIG. 3E. As shown in FIG. 3F, the column spacers 305 are formed at both sides of the UV-ray hardening sealant 410, and removes the stress caused by the difference in thickness of substrate. The column spacer 305 positioned in the peripheral region of the UV-ray hardening sealant 410 is removed when cutting the substrate after completing an LCD panel.

FIG. 4A is a plane view of an LCD device using a liquid crystal dropping method according to the present invention. FIG. 4B is an expanded view of showing B of FIG. 4A, according to the first embodiment of the present invention. FIG. 4C is an expanded view of showing B of FIG. 4A, according to the second embodiment of the present invention.

As shown in FIG. 4A, Ag and TFT are formed on a first substrate 400. Then, liquid crystal is dropped on the first substrate 400. Also, a color filter pattern is formed in a second substrate 450, and column spacers 405 are formed in the portion corresponding to a line part excluding a pixel region 412 of the first substrate, and in the portion corresponding to an array peripheral region inside a UV-ray hardening sealant 410. The column spacers 405 are formed of an organic resin material, wherein the column spacers 405 are formed on the second substrate 450 by exposure and development. After forming the column spacers 405, the second substrate 450 is positioned above the column spacers 405. Then, after forming an LCD panel by bonding the first and second substrates to each other, UV ray is provided and the UV-ray hardening sealant 410 is hardened. The UV-ray hardening sealant 410 may be formed narrower or wider than a black matrix 430.

The UV-ray hardening sealant 410 may shrink during the hardening process. Thus, it is possible to add a thermal hardening sealant to the UV-ray hardening sealant.

A cell gap of an active area 420 is maintained with the column spacer 405 provided in the inside of the array. Also, a cell gap of the UV-ray hardening sealant 410 is maintained with the column spacer 405 provided in the outside of the array. The column spacer has a width of about 5 ㎛ to 30 ㎛. The column spacer 405 may be formed of an organic resin material, or may be formed of any photo-sensitive resin material.

FIG. 4B is an expanded view of showing B of FIG. 4A, according to the first embodiment of the present invention. In FIG. 4B, a column spacer 405 is formed in an array peripheral region inside a UV-ray hardening sealant 410. As shown in the drawing, the plurality of column spacers 405 are formed so as to maintain a gap of the UV-ray hardening sealant 410. In this case, since the plurality of column spacers 405 are provided, it is possible to remove the stress caused by an adhesive of the UV-ray hardening sealant 410.

FIG. 4C is an expanded view of showing B of FIG. 4A, according to the second embodiment of the present invention. In FIG. 4C, column spacers 405 are formed in the inside of a UV-ray hardening sealant 410 and in a peripheral region of the UV-ray hardening sealant 410. A cell gap of an active area 420 is maintained with the column spacer 405 formed in the inside of the array, thereby maintaining a uniform cell gap in the entire surface of the LCD device. Then, column spacers 405 provided in the inside and peripheral region of the UV-ray hardening sealant 410 maintain a gap at both sides thereof. That is, the column spacers 405 can remove the stress caused by the UV-ray hardening sealant 410. At this time, at least two column spacers 405 are provided, that is,

one column spacer 405 is provided in each of the inside and outside parts of the UV-ray hardening sealant 410.

FIGs. 5A to 5G are cross-sectional views of a process of manufacturing an LCD device using a liquid crystal dropping method according to the present invention.

As shown in FIG. 5A, Ag 401 is coated on a first substrate 400.

FIG. 5B shows column spacers 405 formed in the inside and outside of an array of a second substrate 450. Inside the array, the column spacer 405 is formed in the second substrate 450 corresponding to a line part of the first substrate 400. Outside the array, the column spacers 405 are formed at both sides of a UV-ray hardening sealant.

FIG. 5C shows the UV-ray hardening sealant 410 coated on the second substrate 450.

FIG. 5D shows that a predetermined quantity of liquid crystal 403 is dropped on the first substrate 400. The second substrate 450 is disposed over the first substrate 400 to confront in a bonding machine, and the first and second substrates 400 and 450 are then bonded to each other. In other words, the second substrate 450 is fixed to an upper stage 470, which enables to move in a Z-axis direction (upper/lower directions), of the bonding machine. Meanwhile, the Ag 401 is disposed on a peripheral region of the UV-ray hardening sealant 410 on the first substrate 400. And, the first substrate 400 is fixed to a lower stage 460, which enables to move in XY-axes directions (left/right directions), of the bonding machine.

As shown in FIG. 5E, the upper and lower stages 470 and 460 are aligned to each other and then a predetermined degree of vacuum of the bonding machine is achieved.. Hence, the first and second substrates 400 and 450 are bonded to each other. Once both of the substrates 400 and 450 are bonded to each other as the degree of

vacuum of the bonding machine is achieved, a first cell gap is formed and then the bonded substrates 400 and 450 are discharged to the atmospheric environments.

Referring to FIG. 5F, once the bonded substrates 400 and 450 having the first cell gap are discharged to the atmospheric environments, a difference between an inner pressure of the LCD panel and the atmospheric pressure generates a second cell gap between the bonded substrates 400 and 450. In this case, the dropped liquid crystal becomes a liquid crystal layer 403a having a uniform thickness.

Referring to FIG. 5G, the bonded substrates 400 and 450 are placed on a quartz stage 480. A UV-ray is then applied to the bonded substrates from a lower side of the first substrate 400 to photo-harden the UV-ray hardening sealant pattern 410.

[ADVANTAGES OF THE INVENTION]

As mentioned above, the LCD device and the method for fabricating the same according to the present invention have the following disadvantages.

First, the column spacers are formed at least one of the outside and inside areas of the UV-ray hardening sealant pattern, thereby enabling to minimize degradation of the cell gap around the UV-ray hardening sealant pattern.

Second, the column spacers are formed at least one of the outside and inside areas of the UV-ray hardening sealant patter, whereby the possible stress of the substrates can be released by the UV-ray hardening sealant.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. An LCD device comprising:

first and second substrates;

gate and data lines, formed on the first substrate, for defining a unit pixel region;

column spacers formed on the second substrate corresponding to the inside of the pixel region and an peripheral region of an array;

a sealant formed on the second substrate; and

a liquid crystal layer between the first and second substrates.

2. The LCD device of claim 1, wherein the sealant is formed of a UV-ray hardening sealant.

3. The LCD device of claim 2, wherein the UV-ray hardening sealant includes a thermal hardening sealant.

4. The LCD device of claim 1, wherein the column spacer provided in the peripheral region of the array is formed between a sealant deposition part and the peripheral region of the array.

5. The LCD device of claim 4, wherein the column spacers provided in the peripheral region of the array are formed at both sides of the sealant deposition part.

6. The LCD device of claim 1, further comprising an alignment layer formed at least any one of the first and second substrates.

7. The LCD device of claim 1, wherein the liquid crystal is formed by dropping liquid crystal on the first substrate or the second substrate.

8. A method for fabricating an LCD device comprising:

defining a unit pixel region by forming gate and data lines on a first substrate;

forming column spacers on the second substrate corresponding to the inside of the pixel region and a peripheral region of an array;

forming a sealant on the second substrate; and

forming a liquid crystal layer between the first and second substrates.

9. The method of claim 8, wherein the sealant is formed of a UV-ray hardening sealant.

10. The method of claim 9, wherein the UV-ray hardening sealant includes a thermal hardening sealant.

11. The method of claim 8, wherein the liquid crystal is dropped on the first substrate or the second substrate.

12. The method of claim 8, wherein the column spacer provided in the peripheral region of the array is formed between a sealant deposition part and the

peripheral region of the array.

13. The method of claim 8, wherein the column spacers provided in the peripheral region of the array are formed at both sides of the sealant deposition part.